



ISA – The Instrumentation, Systems, and Automation Society

Brazos Section

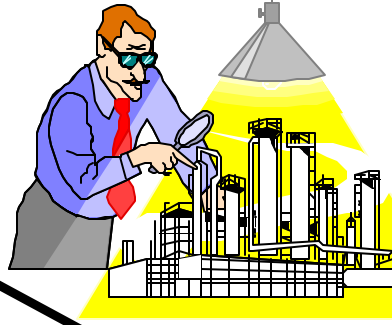
An Overview of Hazardous (Classified) Location Area Electrical Classification

by

David Wechsler

April 3, 2003

Area Electrical Classification



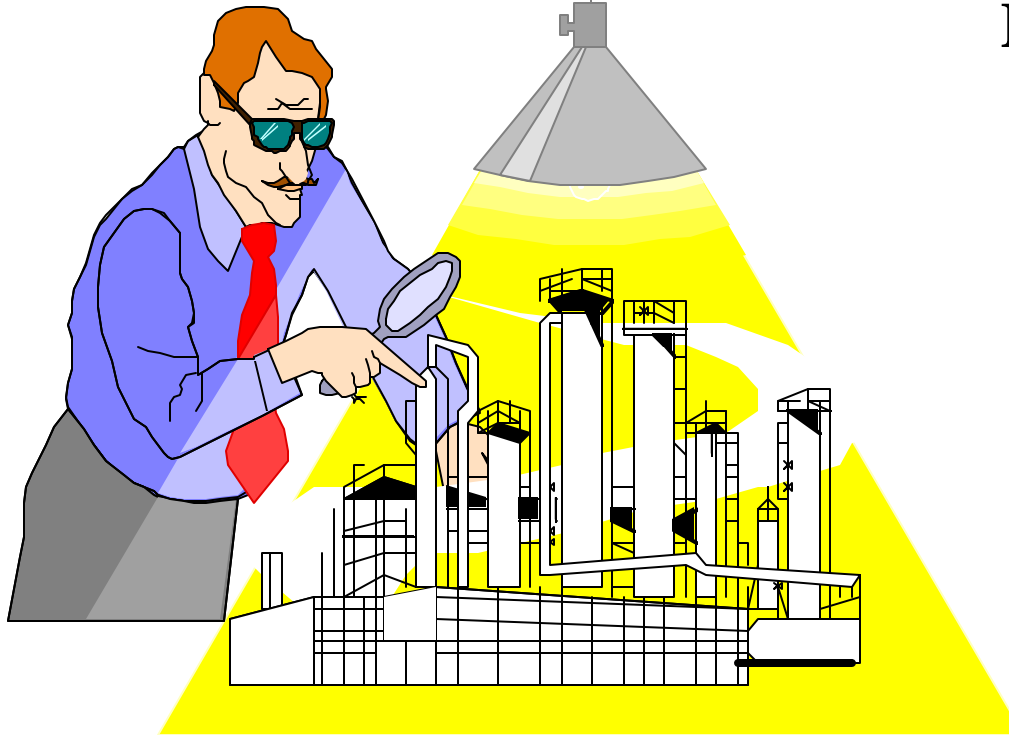
Installation of Electrical Equipment Hazardous Area

- Explosion proof
- Pressurized
- Oil Immersion
- Non incendive
- Hermetically sealed
- Intrinsic Safety

Electrical Apparatus Certifications, Listings Markings

Area Electrical Classification

**What's involved with it?
Risk Assessment**



What is an Area Electrical Classification?

Risk based methodology used to quantify material characteristics with potential electrical ignition sources resulting in the objective of reducing a fire/explosion potential.

Areas found to be applicable are considered **“hazardous (classified) locations”**.

Location Electrical Classification Team

**Develop Classification Team Procedural Plan
that defines:**

Objectives Electrical Classification
Team Members and responsibilities
Documentation of Classification work

The Area Electrical Classification Team

- Assemble team

**Minimum 3 people with expertise levels -
Operations - process
Electrical - maintenance and design
Process Safety**



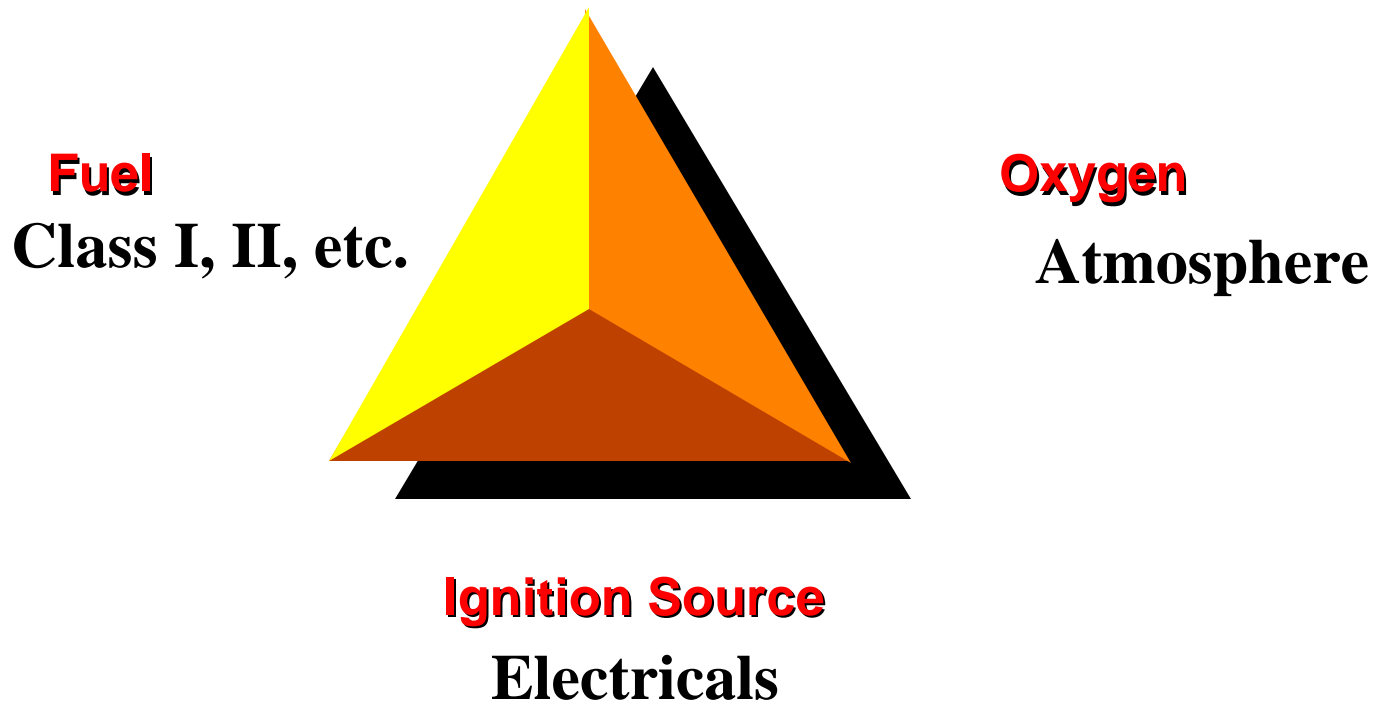
Location Electrical Classification Team

Maintain well documented, complete, area Electrical Classification information that is readily available.

Suggestion: Use dated Classification Drawing to reflect Specific Materials and their Material Group, AIT Notes if the classification is different from “Standard” criteria
Notes to link supportive information i.e., purged building

The Fire Triangle

The Hazardous (Classified) Location Methodology



Data Collection

What are the processing conditions?

What materials are used?

Where are the materials used?

How are the materials used?

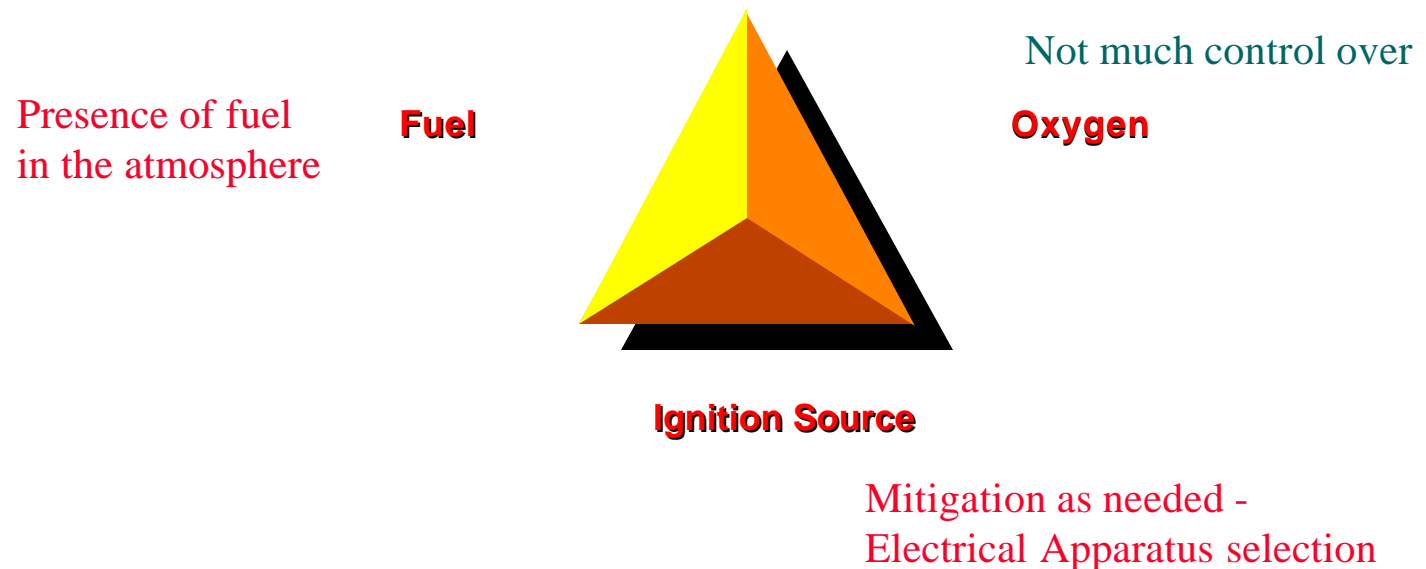
Are there any ignition sources, actual or potential, in the area?

Note: Not all potential ignition sources are electrical in nature.
Example, High pressure steam lines.

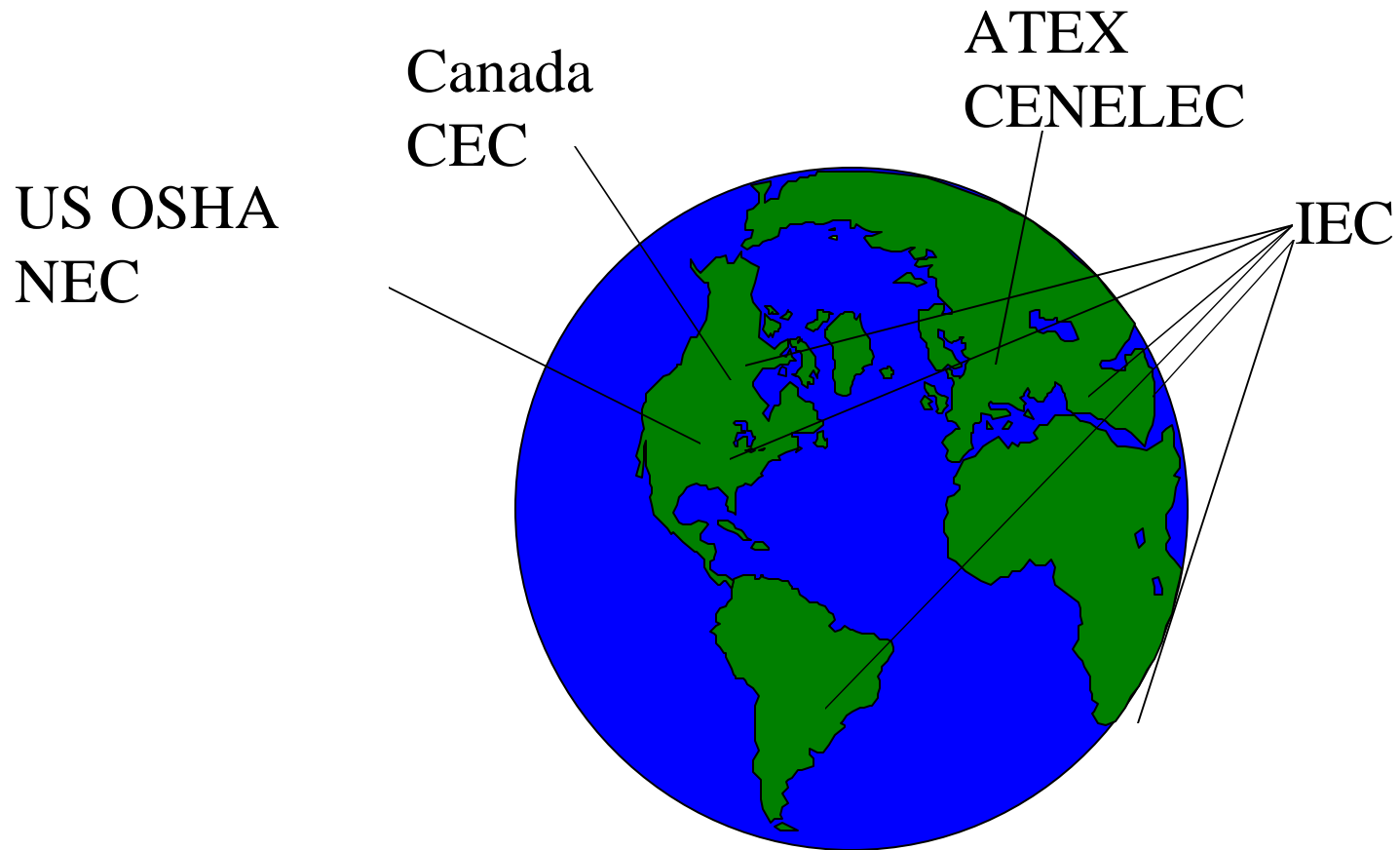
Assessment of Risk

What is the Risk?

The Fire Triangle



the Standards World



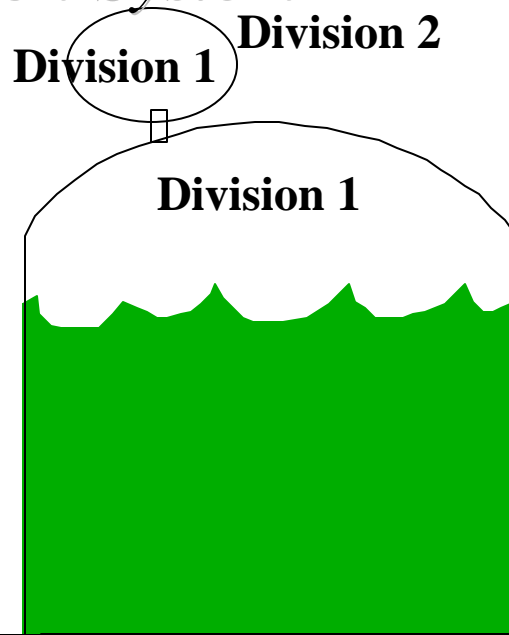
Comparison Classification Methodologies

- “Class, Division”
 - Class I, Division 1
 - Class I, Division 2
 - Unclassified
 - Group A
 - Group B (hydrogen)
 - Group C (ethylene)
 - Group D
 - T Code T1, T2, T2A-D, T3, T3A-C, T4-A, T5, T6 (450-85 C)

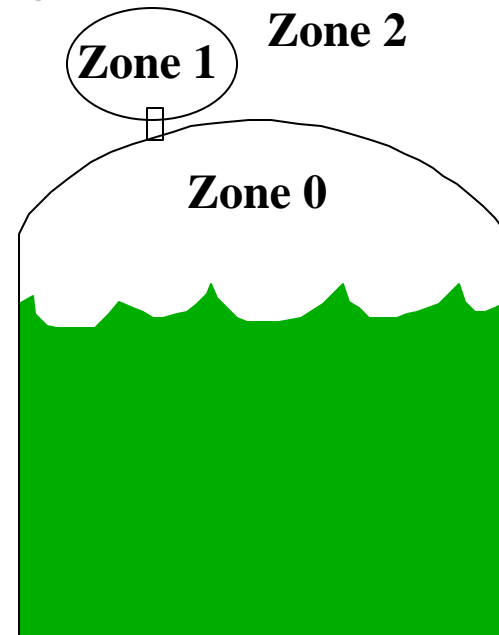
- “Zone 0”
 - Zone 0
 - Zone 1
 - Zone 2
 - Unclassified
 - Group IIC
 - Group IIC
 - Group IIB
 - Group IIA
 - T Code T1-T6

(450-85 C)

Division System



Zone System



HazLoc Classification based upon the NEC

I. Definitions and Explanations

A. Class I, II, III - Define the material

B. Divisions- Address the risk; probability and frequency the material being present in hazardous (ignitable) concentrations.

Division 1 - Present frequently

Division 2 - Present only under abnormal operations

Unclassified - Not likely to be present at all

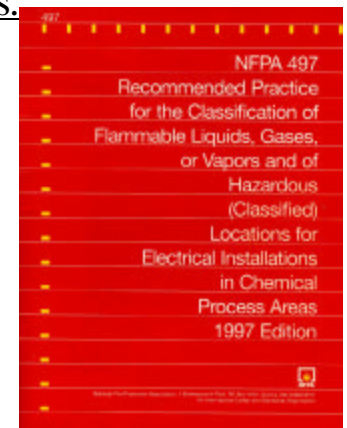


NEC Group B(D) Clarification

Example, NFPA 497 Selected Class I Chemicals

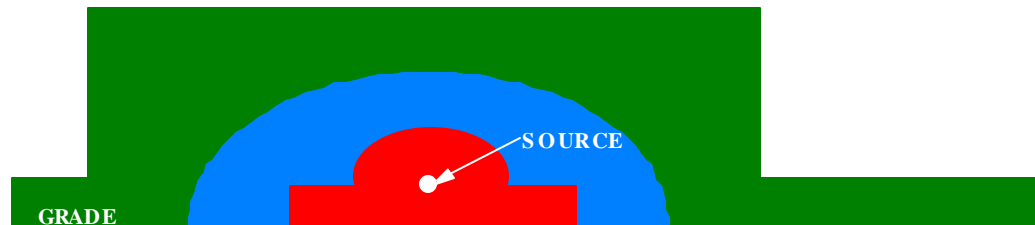
Material	CAS No.	NEC Group	Flash point °C	AIT °C	%LFL	%UFL	Vapor Density
Styrene	100-42-5	D	31	490	0.9	6.8	3.6
Isoprene	78-79-5	D	-54	220	1.5	8.9	2.4
Butadiene	106-99-0	B*D	-76	420	2	12	1.9

Note: B*D means this material exhibits properties that places it into the Group B category. However, permission to use Group D electrical equipment is given, provided all conduit ½ in. and larger is sealed. This is a design choice and for classification purposes the area(s) where this material is used should be reflected as Group B*D locations.



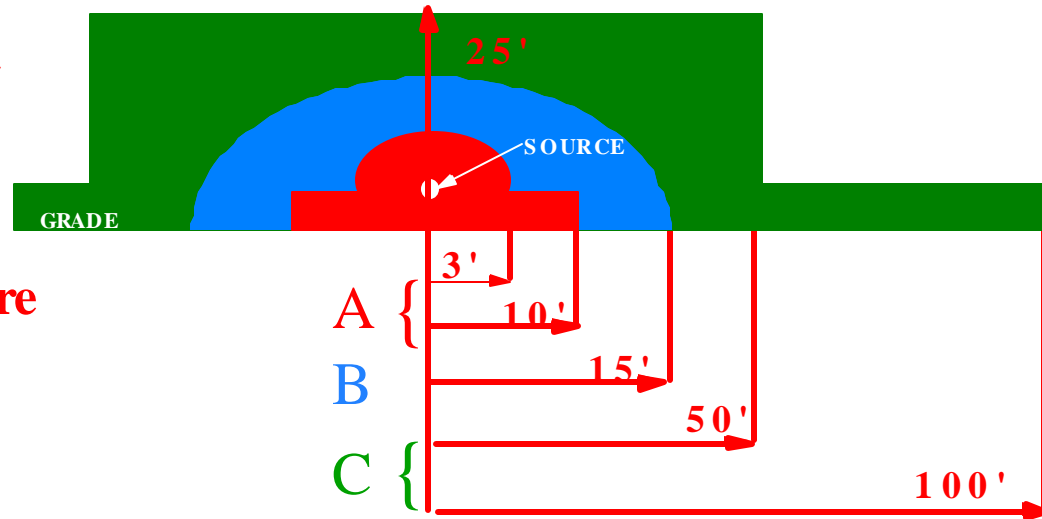
NFPA 497 - Process Equipment

Effects of Size Pressure Flow



Process Equipment	Small/ Low	Moderate	Large/ High
Size (gallons)	<5 0 0 0	5 0 0 0 - 2 5 0 0 0	> 2 5 0 0 0
Pressure (psi)	<1 0 0	1 0 0 - 5 0 0	>5 0 0
Flow Rate (gpm)	<1 0 0	1 0 0 - 5 0 0	>5 0 0

NFPA 497
Effects of
Size
Pressure
Flow



A

Process Equipment	Small/ Low	Moderate	Large/ High
Size	✓	✓	
Press	✓	✓	
Flow	✓	✓	

B

Process Equipment	Small/ Low	Moderate	Large / High
Size	✓	✓	
Press		✓	✓
Flow	✓	✓	

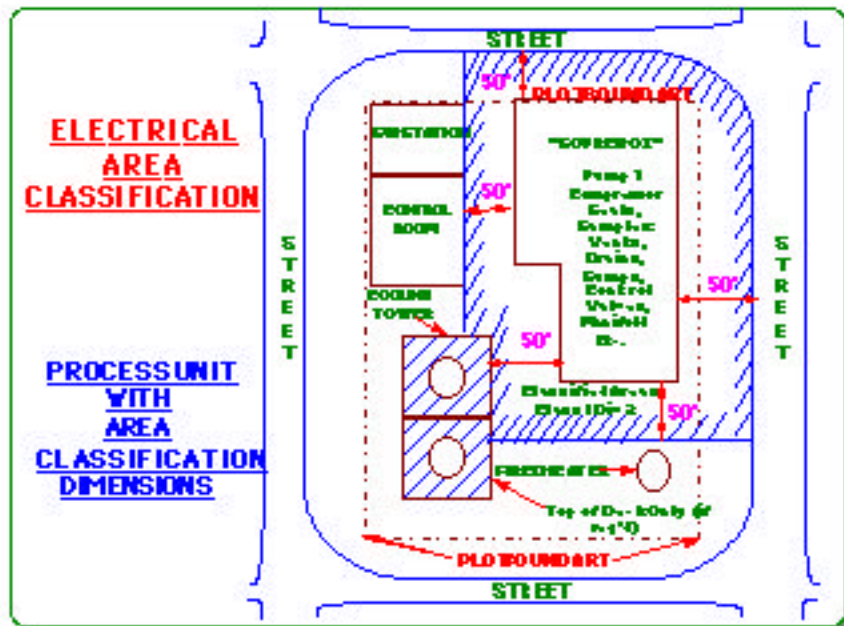
C

Process Equipment	Small/ Low	Moderate	Large/ High
Size			✓
Press		✓	✓
Flow			✓

Classification Documentation

Classification Drawing should contain:

- Specific chemical(s), AIT, Group information
- Notes regarding classification details
- Approvals with signatures for
Process Engineering
Manufacturing
Control Systems/Electrical
Safety
- Dates for drawing, Revisions, and sign-offs



Combustible Dust - Ignitable Fiber Zone

New NEC proposal

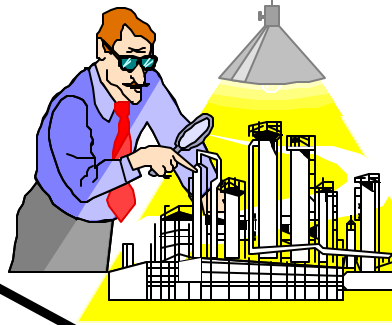
(under consideration)

Existing:

Proposed:

NEC Article 502 - Combustible Dusts	NEC Article 506 - Zone 20, 21, and 22 Locations for Flammable Dusts, Fibers, and Flyings
NEC Article 503 - Ignitable Fibers	
Class II, Division 1 Division 2 Unclassified Groups E, F, and G	Zone 20 Zone 21 Zone 22 Unclassified
Class III, Division 1 Division 2 Unclassified	No groups

Area Electrical Classification

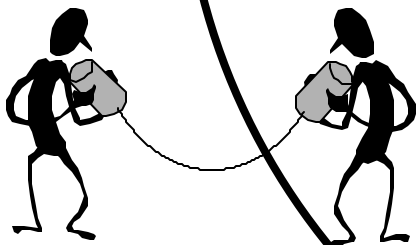


Electrical Apparatus Considerations

Hazardous Area

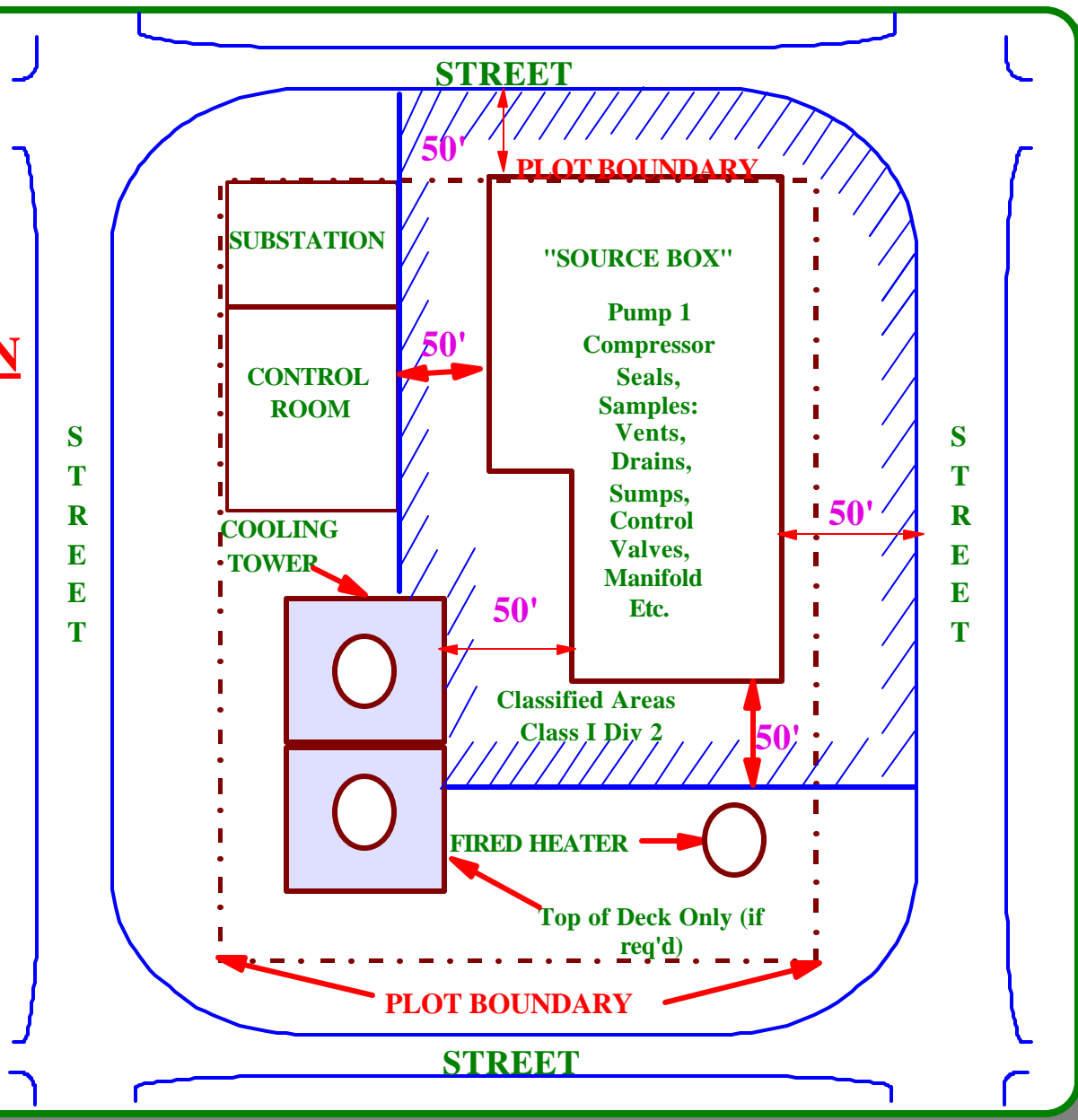
- Explosion proof
- Pressurized
- Oil Immersion
- Non incendive
- Hermetically sealed
- Intrinsic Safety

Electrical Apparatus Certifications, Listings Markings

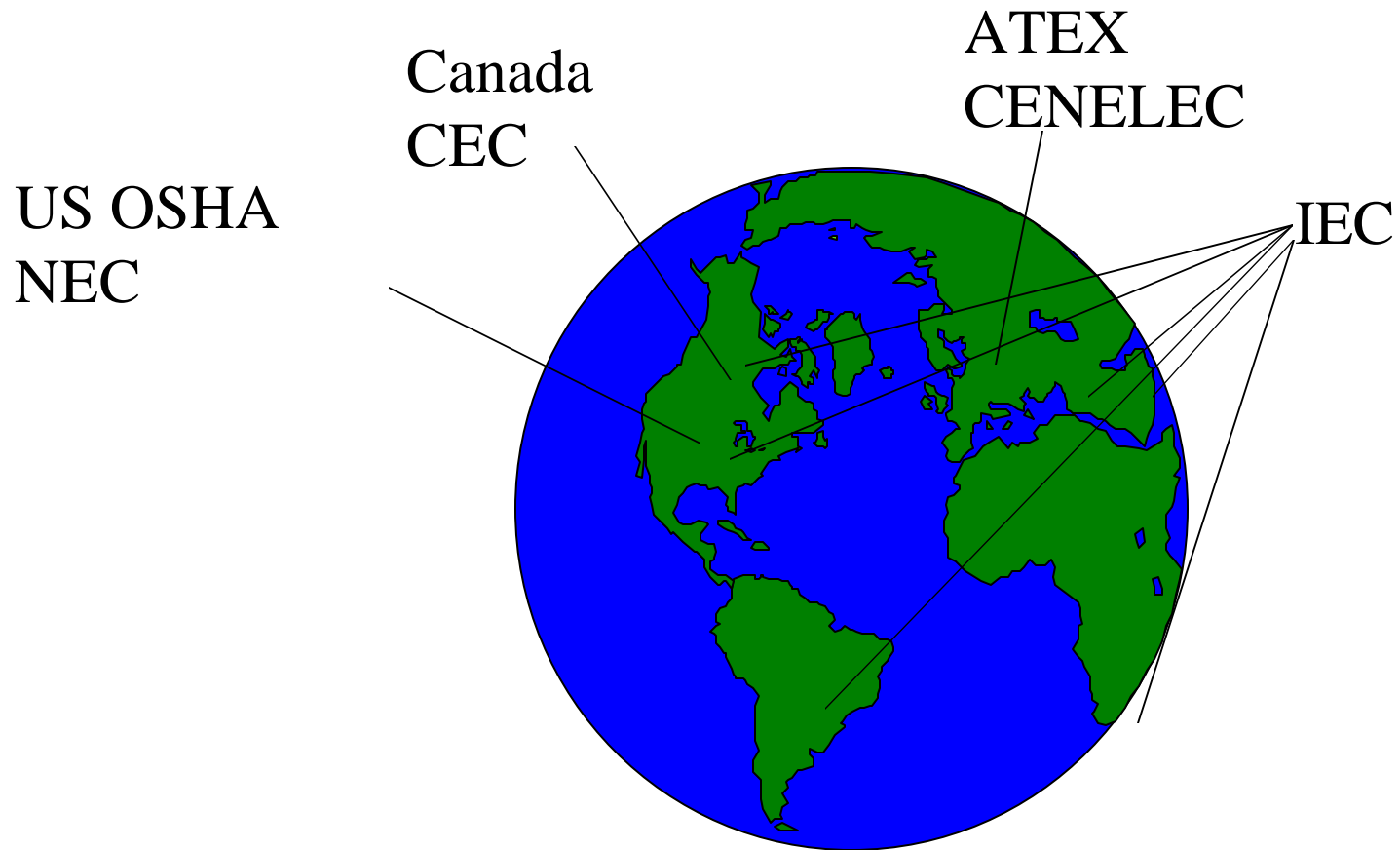


ELECTRICAL
AREA
CLASSIFICATION

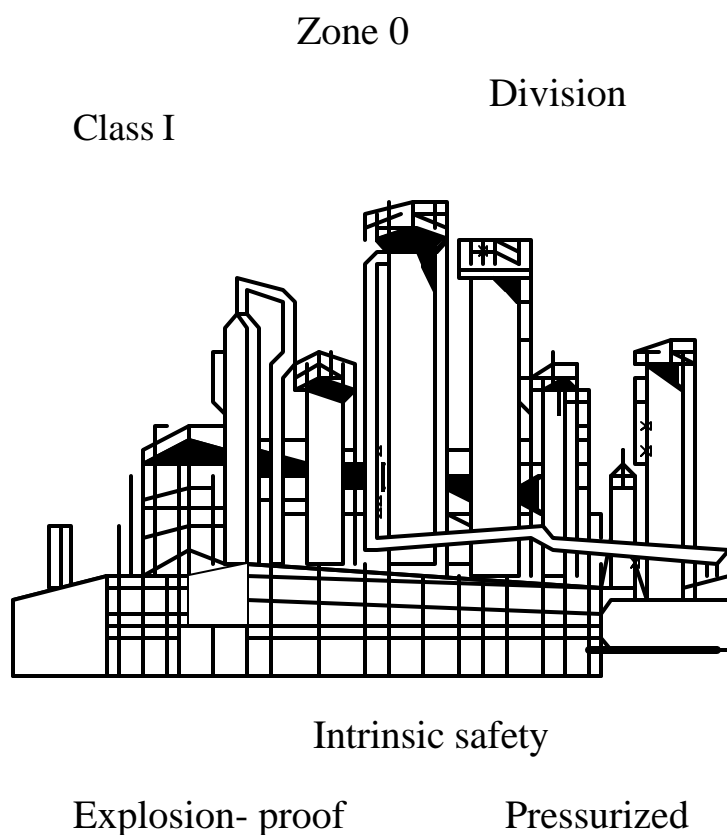
PROCESS UNIT
WITH
AREA
CLASSIFICATION
DIMENSIONS



the Standards World



Decisions, decisions....



Affecting:

Instrumentation Control Systems
Area Electrical Classification
Equipment, Installation,
Maintenance

Equipment Type Comparisons

Electrical Code

- US Electrical Code
- Class, Division
 - Explosion proof
 - Pressurized
 - Oil Immersion
 - Non incendive
 - Hermetically sealed
 - Intrinsic safety (partial)

- IEC Electrical Codes
- Zone 0
 - Flameproof
 - Pressurized
 - Oil Immersion
 - Non sparking
 - Encapsulated
 - Intrinsic safety (full)
 - Increased safety
 - Special protection

Installation Consideration Comparisons

US Electrical Code

- Conduit with Explosionproof seals
- Cable Tray
- Thread type and engagement
- Wire gauge/ampacity
- Grounding/bonding

IEC Electrical Codes

- Cable, with Cable glands
- Cable Tray
- Metric Thread type and engagement
- Wire gauge/ampacity
- Earthing

Equipment selection

Some considerations -

What is the application?

What is the best functional apparatus within cost considerations?

Installation and wiring/cabbling method?

Is the apparatus available as being “suitable” for the Area Electrical Classification?

Is the apparatus “**suitable**” for the Area Electrical Classification?

Suitability of identified equipment may be determined by one of the following:

(1) Equipment listing or labeling

(2) Evidence of equipment evaluation from a qualified testing laboratory or inspection agency concerned with product evaluation

(3) Evidence acceptable to the authority having jurisdiction such as a manufacturer's self-evaluation or an owner's engineering judgment

Cross-Fertilization of Electrical Apparatus

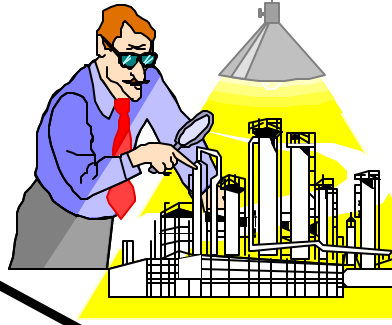
Can IEC electrical apparatus be installed as a general rule in a US Class I, Division 2 location?

Answer: **Highly probable**

Can IEC electrical apparatus be installed as a general rule in a US Class I, Division 1 location?

Answer: **Only if you are one of those unique folks that daily enjoys running 25 miles, when the temperature exceeds 101F and the humidity exceeds 88%, you might find a way, but not as a general installation rule.**

Area Electrical Classification

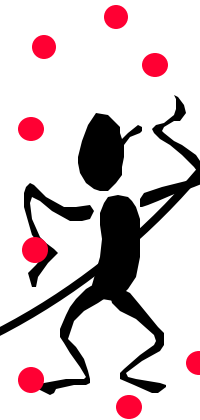


Electrical Apparatus Considerations

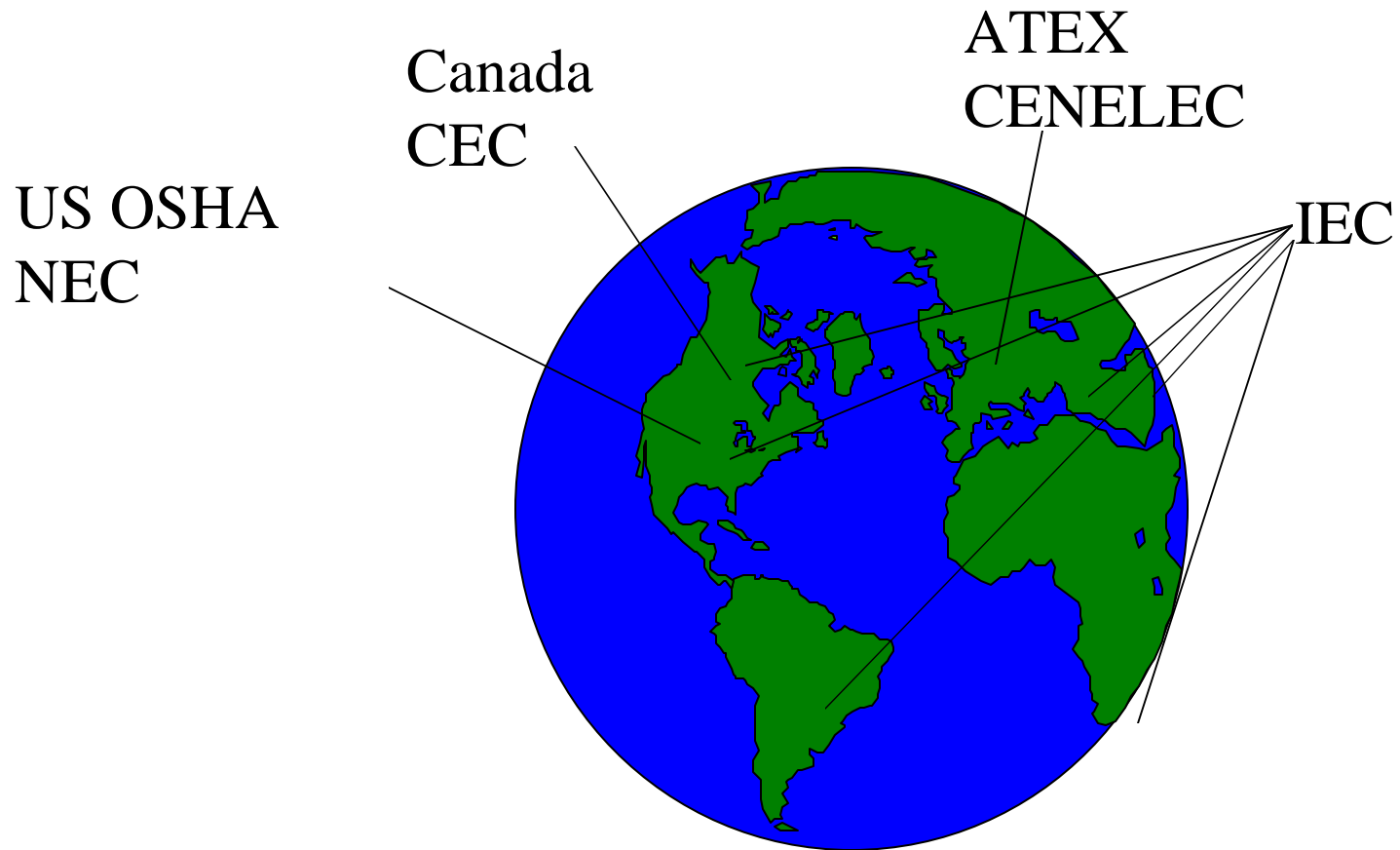
Hazardous Area

- Explosion proof
- Pressurized
- Oil Immersion
- Non incendive
- Hermetically sealed
- Intrinsic Safety

Electrical Apparatus Certifications, Listings Markings



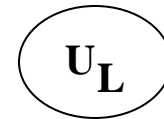
the Standards World



Electrical Equipment Markings

United States

Underwriter Laboratory Listing



Factory Mutual Approval

Factory
Mutual
System
Approved

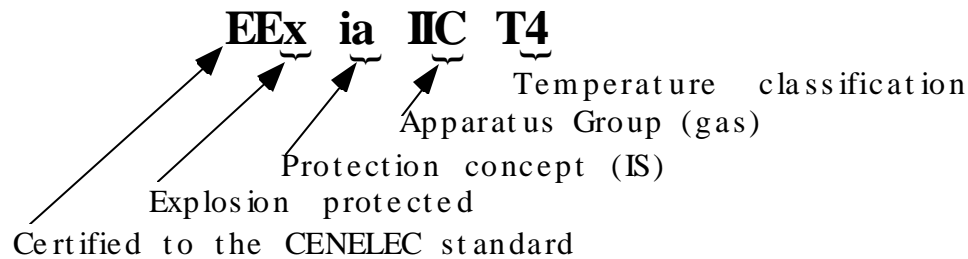
Canada

Canadian Standards Approval Certification



Equipment Marking

CENELEC & IEC



	Protection Code
d	Flameproof
ia	Intrinsic Safety
e	Increased Safety
p	Pressurization
n	Non-incendive
s	Special

IP or Ingress Protection Codes

First numeral
Protection Against solid bodies

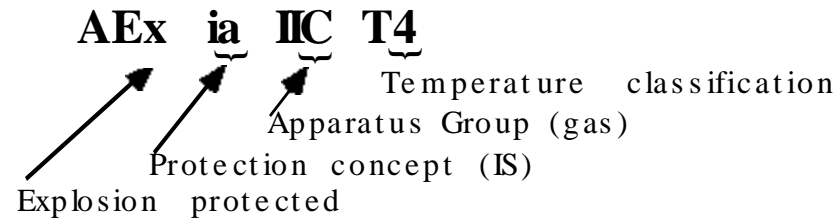
0	No protection
1	Objects greater than 50 mm
2	Objects greater than 12 mm
3	Objects greater than 2.5 mm
4	Objects greater than 1.0 mm
5	Dust-Protected
6	Dust-Tight

Second Numeral
Protection Against liquid

0	No protection
1	Vertically dripping water
2	Angle dripping water
3	Sprayed water
4	Splashed water
5	Water jets
6	Heavy seas
7	Effects of immersion
8	Indefinite immersion

Equipment Marking

US - IEC



	Protection Code
d	Flameproof
ia	Intrinsic Safety
e	Increased Safety
p	Pressurization
n	Non-incendive
s	Special

IP or Ingress Protection Codes

First numeral
Protection Against solid bodies

0	No protection
1	Objects greater than 50 mm
2	Objects greater than 12 mm
3	Objects greater than 2.5 mm
4	Objects greater than 1.0 mm
5	Dust-Protected
6	Dust-Tight

Second Numeral
Protection Against liquid

0	No protection
1	Vertically dripping water
2	Angle dripping water
3	Sprayed water
4	Splashed water
5	Water jets
6	Heavy seas
7	Effects of immersion
8	Indefinite immersion

IP vs NEMA

30	1
31	2
32	3 R
64	3
65	12, 12X and 13
66	4 and 4X

ATEX Marking

ID-Number of
Notified Bodies

Equipment Group

Category

Gas (G) or Dust (D)

Zone 0

CE 0102 II 1 G $\text{\textcircled{Ex}}$

EXLUX 6008/142-8 *◀ Example for type of series*

R. Stahl *◀ Example for Manufacturer*

ATEX 100

EEx de IIB T4 *◀ Example for type of explos. protection*

PTB 96 ATEX 2144X *◀ Example for test number*

EN 50014

Zone 1

CE 0102 II 2 G $\text{\textcircled{Ex}}$

EEx ia IIC T4 *◀ Example for type of explos. protection*

PTB 96 ATEX 3844X *◀ Example for test number*

Zone 2

CE 0102 II 3 G $\text{\textcircled{Ex}}$

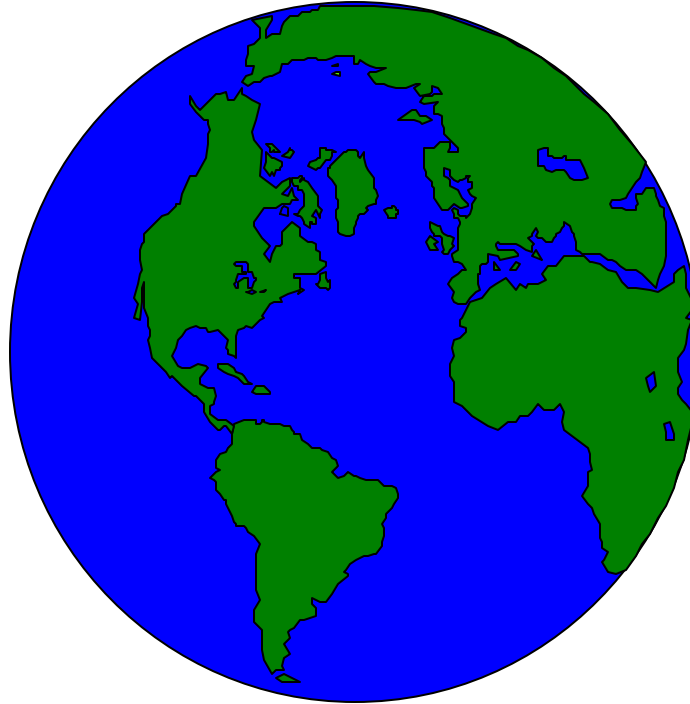
EEx n IIA T4 *◀ Example for type of explos. protection*

PTB 96 ATEX 3244X *◀ Example for test number*

Certifications

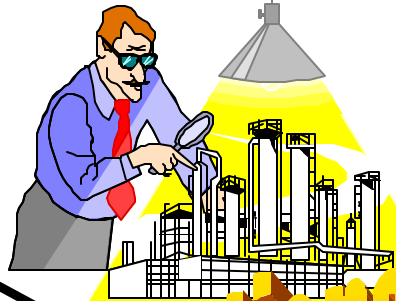
Country	Applicable Certification
USA	Nationally Recognized Testing Laboratory (NRTL)- example: FM, UL, ETL
Canada	Standards Council of Canada certified body- example: CSA
Europe	ATEX- EU Notified Body
Australia	ANZEx scheme for certification body

The certification “mark” will drive where the electrical apparatus may be installed.



While an objective is to be able to have globally acceptable markings, there currently is none yet.

Area Electrical Classification



QUESTIONS?

Installation of Electrical Apparatus
Electrical Equipment in Hazardous Areas
Certifications, Listings
Markings

- Explosion proof
- Pressurized
- Oil Immersion
- Non incendive
- Hermetically sealed
- Intrinsic Safety



The Speaker - Dave Wechsler is a Global Process Safety Technology Leader located at the Dow Chemical Freeport TX facility. He is also the Technical Resource Leader for Dow's Global Electrical Area Classification Technical Resource Network which is the core group that addresses area classification issues for the Dow Chemical Company locations, globally. Dave is the Principle American Chemistry Council, formerly CMA, representative on the NEC CMP-14

responsible for the Chapter 5 Hazardous (Classified) Locations Articles, and on the Electrical Equipment in Chemical Atmospheres (EECA) that is responsible for NFPA 496, 497 and 499, as its former vice chairman. A senior member of ISA, Dave is also very active on SP12 and many of its hazardous locations committees. He is also a member of the ANSI/IEC -Technical Advisory Group working with IEC standards representing "user" interests.